Health, Sports & Rehabilitation Medicine
Vol. 23, no. 4, October-December 2022, 169–173

Validity of a new mobility screening for primary school children

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Abstract

Background. Children with motor deficits need to be identified early in order to initiate appropriate therapies. Detailed motor tests are often time-consuming and costly. In contrast, a screening makes it possible for teachers to test their school class within one lesson.

Aims. Therefore, a new mobility screening for children from six to eight years, based on the International Classification of Functioning, Disability and Health for Children and Youth, has been validated.

Methods. In total, 196 primary school children (87 are girls, 109 boys, age of 7.39 ± .77 years) participated. All underwent the new MobiScreen version for children from six to eight years. Task split times, and total times were taken. Tasks are evaluated by points, and added to a total score. Construct validity, and discriminant ability were evaluated. The significance level was set at $p<.05$.

Results. The factor analysis for item split times reveals a one-factor model with a component (eigenvalue of 3.63, variance explication 73 %). The factor analysis for item scores shows a two-factor model with two components (eigenvalues 1.61 and 1.14, cumulated variance explanation 55 %). The discriminant analysis shows significant differences for all variables apart from scores for slalom and crawling.

Conclusions. The assumed one-factor model of mobility can be confirmed for item split times. The MobiScreen version for children from six to eight years is able to differentiate between healthy children and children with a medical diagnosis. For this, further validation steps can follow (criterion validity and diagnostic accuracy). A study on this has already been initiated.

Keywords: mobility, motor development, assessment, screening, validity, primary school.

Introduction

For children with motor deficits, as for healthy children, participation in social life is of great importance, specified by the International Classification of Functioning, Disability and Health for Children and Youth ICF-CY (Hollenweger & de Camargo, 2013). With participation as a diagnostic criterion, limitations of the patient in age-appropriate activities can be described and, based on this, these circumstances can be improved (Strassburg, 2010). Mobility, in particular, is therefore of great importance to those affected (Strassburg et al., 2008). The ICF-CY provides a good basis to systematically classify the impairment of children with a motor development disorder (Jaščenoka & Petermann, 2018). The aim of this classification is to provide a language for describing health and health-related conditions in a uniform and standardized way. It enables data comparisons between different countries, health disciplines and services. Mobility as defined by the ICF-CY describes moving oneself or moving and handling objects, getting around in different ways, and using transportation. Without it, participation does not take place. This is because participation plays an overriding role, as children's life situations are constantly changing throughout their development (Hollenweger & de Camargo, 2013). The urge to participate is innate and can be considered the strongest developmental motor that is an unmistakable part of early childhood development (Michaelis & Niemann, 2017).

If we relate this to the everyday life of children with motor deficits or a motor development disorder, we find that their movements are poorly timed and arrhythmic, as well as inefficient, and that these children have poorer postural control, which can interfere with the acquisition of gross motor skills (Schott, 2010), e.g., they learn to ride a bicycle or swim later compared with healthy peers (Esser & Petermann, 2010). They show problems with teetering and climbing, walking on uneven ground, and running and stopping or changing direction and throwing. They are usually conspicuous by clumsiness, frequent falls, or dropping objects (Jaščenoka & Petermann, 2018). Other deficits are evident in activities of daily living such as eating with a knife and fork, dressing and undressing, tying shoes,

Received: 2022, October 8; *Accepted for publication:* 2022, October 15
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https://doi.org/10.26659/pm3.2022.23.4.169

or doing puzzles. It is precisely these problems that make it difficult for children with motor deficits or even disorders to integrate into everyday life. Even in kindergarten, affected children are conspicuous for their clumsiness. However, the disorders only become relevant when higher gross and fine motor requirements are placed on the children, usually when they start school. An exact diagnosis already in kindergarten is therefore of high practical importance (Suchodoletz, 2005). On a standardized motor test, these children have scores that are at least 1.5 standard deviations below the level that would be expected based on the child's chronological age (***, 2005).

Detailed motor tests are often time-consuming and costly. As part of a sequential diagnostic strategy, a screening should be performed in the first step. Only children who show an abnormal test result are further investigated with a detailed motor test. Thus, the testing procedure is kept low for both the tester and the children (Tröster et al., 2004). Such a screening makes it possible for teachers to test their school class within one lesson.

Screenings, like detailed tests, must meet psychometric standards to provide reliable information about the child's condition. These include the criterion of validity. Validity indicates the degree of accuracy with which the test actually measures the characteristic it is intended to capture (Lienert & Raatz, 1988). To examine construct validity, a factor analysis is usually conducted, which allows one to determine how many factors can explain a test. It is important to note prerequisites and limitations when conducting a factor analysis (Bös, 2017). Another criterion of validity is the ability of a test procedure to differentiate between populations (Kubinger, 2006). Thus, in a developmental test designed to separate children with motor problems from healthy children, it is precisely these two populations that must be compared. This is achieved through discriminant analysis. In this way, certain variables can be discovered that predict group membership (Leonhart, 2013). The known mobility screening for children aged four to six years, MobiScreen 4-6, is based on the domain of mobility of the ICF-CY. MobiScreen 4-6 is a so-called filter test, which reliably identifies the conspicuous children as such. These children must be further examined with a detailed motor test. The screening consists of the tasks "Getting up from lying position", "Slalom", "Climbing", "Crawling", "Maneuvering" and "Transporting". The tasks are arranged as a course to be run through (Dincher, 2020).

Initial studies have shown that although the version for kindergarten children has adequate quality criteria for the 6-, 7- and 8-year-old age groups, the test items are too simple. Therefore, a new modified version, MobiScreen for children between six to eight years old, is to be validated. Initial reliability parameters have already been confirmed for this new version. The coefficients for the interrater reliability are between excellent values of .86 and 1.00, Cronbach's alpha reaches an acceptable value of .89 (Dincher & Dincher, 2022). The following Figure 1 shows the structure of this new version.

The MobiScreen for children from six to eight years is a new procedure to be used as a first step in the diagnostic process. Whether the one-factor model of mobility in the sense of the ICF-CY can be confirmed in this MobiScreen version and whether it can also differentiate between healthy children and children with a medical diagnosis (e.g. ADHD, physical or mental disability, etc.) is investigated in the present study.

Hypothesis

The new MobiScreen version for first and second graders has a good construct validity and differentiation ability.

Material and methods

Research protocol

a) Period and place of the research

After consent from the education ministry, primary schools were randomly selected. After consent of their heads and the children's parents, four days were taken to test in the schools. In total four testers carried the tests out. The study took place in June 2022.

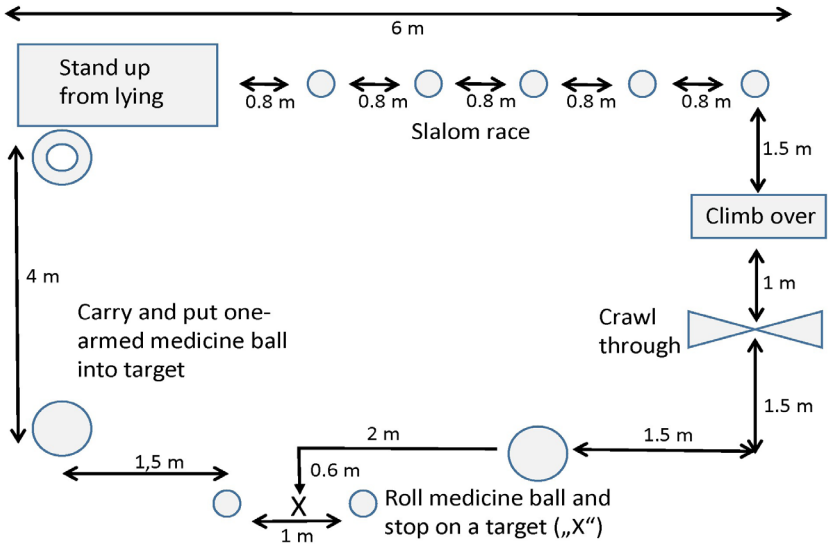

Fig. 1 – Structure plan of the MobiScreen version for children from six to eight years (Dincher & Dincher, 2022).

Table I
Overview of the characteristics of the total sample and separated by boys and girls.

Gender	n	Age (years) M ± SD	Height (m) M ± SD	Weight (kg) M ± SD	BMI M ± SD	Sport	Diagnosis	Migration
Total sample	196	7.39 ± .77	1.30 ± .09	27.55 ± 5.49	17.41 ± 3.38	103	39	23
Boys	109	7.41 ± .75	1.29 ± .09	27.35 ± 5.32	17.37 ± 3.39	62	25	12
Girls	87	7.29 ± .81	1.30 ± .08	27.37 ± 5.97	17.54 ± 3.63	41	14	11

Legend: n = sample size, M ± SD = mean ± standard deviation, sport = member of sports club, diagnosis = doctor-confirmed diagnosis, e.g. ADHD, mental or physical disability, migration = migration background.

Table II
Descriptive statistics of all item split times and scores, total time and total score, and comparison of boys and girls in different age classes

Indicator	Boys			Girls			F
	6 years (n=22)	7 years (n=42)	8 years (n=26)	6 years (n=28)	7 years (n=30)	8 years (n=25)	
Time Slalom	5.47 ± .73	4.50 ± .95	5.49 ± 3.59	5.25 ± 1.06	4.36 ± .86	4.88 ± 2.26	.273
Time Climbing	3.79 ± 1.87	2.56 ± 2.03	4.81 ± 5.34	3.27 ± 1.67	2.76 ± 1.03	4.48 ± 5.93	.196
Time Crawling	3.47 ± .91	2.87 ± 1.07	5.34 ± 7.07	3.46 ± 1.65	3.09 ± .89	3.84 ± 1.89	1.342
Time Maneuvering	11.33 ± 5.10	7.98 ± 3.22	9.14 ± 5.85	11.02 ± 5.17	9.47 ± 3.14	11.84 ± 8.78	.969
Time Transporting	4.43 ± 1.59	4.17 ± 1.87	10.07 ± 14.56	5.76 ± 2.84	4.06 ± 1.20	5.48 ± 4.33	3.325*
Total Time	28.66 ± 9.55	22.67 ± 8.04	30.08 ± 36.37	30.43 ± 9.17	25.34 ± 4.80	28.53 ± 23.52	.214
Score Slalom	4.41 ± 1.18	3.55 ± 1.51	3.81 ± 1.41	3.46 ± 1.73	3.27 ± 1.62	3.92 ± 1.38	1.589
Score Climbing	4.95 ± .21	4.95 ± .22	4.54 ± 1.30	4.86 ± .76	5.00 ± .00	4.68 ± 1.11	.336
Score Crawling	8.82 ± .39	4.60 ± 1.06	4.73 ± .53	4.96 ± .19	4.90 ± .31	4.88 ± .33	.338
Score Maneuvering	4.27 ± 1.03	4.10 ± 1.14	4.19 ± 1.39	3.86 ± 1.30	4.27 ± 1.20	3.56 ± 1.33	1.747
Score Transporting	3.77 ± 1.23	4.02 ± 1.16	3.96 ± 1.59	3.93 ± 1.18	4.37 ± 1.07	3.28 ± 1.40	2.578
Total Score	22.23 ± 2.09	21.21 ± 3.02	21.23 ± 3.79	21.07 ± 3.31	21.80 ± 2.38	20.32 ± 3.06	1.511

Legend: n = sample size, M ± SD = mean ± standard deviation, F = F-value of univariate ANOVA for interaction effect age*sex, * = significant p<.05.

b) Subjects and groups

The sample of persons consists of 196 children from two elementary schools. Of these, 87 are girls and 109 are boys. The average age of the children is 7.39 ± .77. Table I provides an overview of the characteristics of the total sample.

There is no significant difference between boys and girls, so the further analyses could be performed for the whole total sample.

c) Applied tests

The MobiScreen version for children from six to eight years is used. The procedure has already been described above. For the present study, the item split times and their scores as well as total time and score are evaluated. The measuring points for the split times are determined as follows:

- Slalom: Leaving mat until first contact with gymnastics box.
- Climbing: First contact with gymnastics box until last contact with it.
- Crawling: Last contact with gymnastics box to first contact with first medicine ball.
- Maneuvering: First contact with first medicine ball to first contact with second medicine ball.
- Transporting: First contact with second medicine ball until safe placement of this ball on the tennis ring (Dincher, 2019).

d) Statistical processing

For all statistical analyses the program SPSS version 26 was used. A t-test was used to compare anthropometric characteristics between boys and girls. A univariate ANOVA was applied to prove the differences in the test results for the interaction age*sex. Construct validity was tested via exploratory factor analysis. Discriminant analysis was used to examine the ability to differentiate between healthy children and children with a medical diagnosis. All analyses were performed for both item split times and their scores, total time and total score. The significance level was set at p<.05.

Results

- *Descriptive results*

In Table II, descriptive results for MobiScreen items and total values are shown, split into boys and girls of the ages of six, seven and eight years.

Only the split time for the transporting task shows a significant difference. Here, the 8-year-old boys need the most time to perform.

- *Explorative factor analysis*

For item split times, the Kaiser-Meyer-Olkin KMO measure of sample adequacy is .81, and Bartlett's test for sphericity is highly significant (p<.001) with a chi-square of 559.09 at 10 degrees of freedom. Thus, the sample of item split times is suitable for main component analysis. For item scores, the KMO measure of sample adequacy is .49, and Bartlett's test for sphericity is highly significant (p<.001) with a chi-square of 69.45 at 10 degrees of freedom. Thus, the sample of item scores is suitable for main component analysis, too.

Figure 2 shows the screeplots of the sample from the item split times and point values and illustrates the eigenvalues of the individual components.

For split times, one component can explain about 73 % of the variance. With a second component, this increases to almost 86 %. For item scores, there are two components with a higher eigenvalue than 1.00. Both together can explain a cumulated variance of about 55 %. A third component would increase the variance explanation to 75 %. For split times, one component with an eigenvalue of 3.63 is clearly visible. The eigenvalues of the remaining components are all below the limit of 1. For item scores, these two components have eigenvalues of 1.61 and 1.14.

Table III shows the component matrix of the factor loadings of the item split times of the items in a one-factor model.

Table III

Component matrix of the main component analysis: factor loadings of the item split times (one-factor-model) and scores (two-factor-model) of the MobiScreen version for children from six to eight years.

Indicator	Component for split times	Component for item scores	
	1	1	2
Slalom	.94	.12	.82
Climbing	.80	.78	-.24
Crawling	.90	.10	.59
Maneuvering	.73	.68	.20
Transporting	.89	.72	-.16

Extraction method: Main component analysis

The factor loadings of the item split times range from .73 to .94 and from -.24 to .82 for item scores. For split times, a one-factor model is shown, for item scores, a two-factor model could be assumed.

- *Discriminant analysis*

Table IV presents the results of discriminant analysis of the MobiScreen items, comparing healthy children to children with a confirmed medical diagnosis (e. g. ADHD, Obesity, Autism etc.).

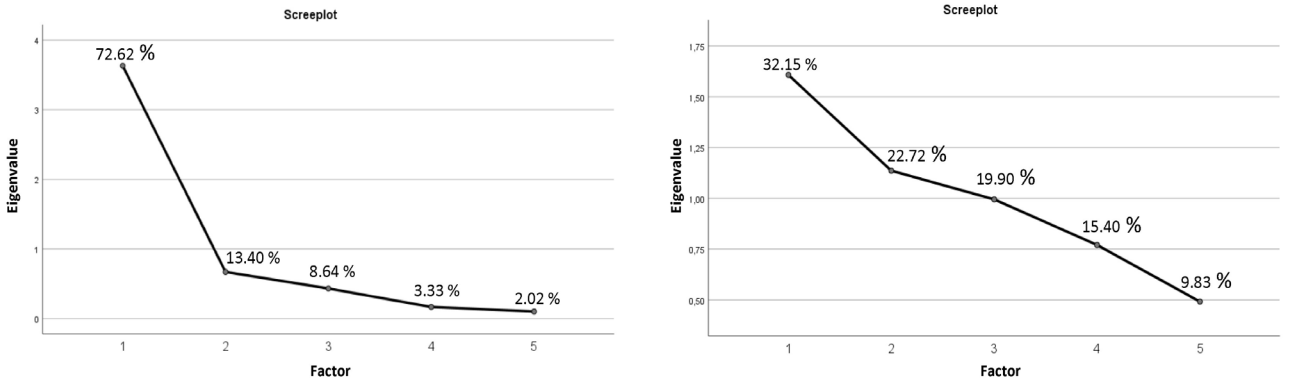

Fig. 2 – Screeplots of the explorative factor analysis for the item split times (left) and scores (right) of the MobiScreen version for children from six eight years.

Table IV

Results of discriminant analysis between healthy children and children with a confirmed diagnosis for item split times, total time, item scores and total score for MobiScreen version for children from six to eight years.

Indicator	Healthy (n=114)	Diagnosis (n=36)	Wilks Lambda	Chi-Square	p
Time Slalom	4.49 ± .96	6.00 ± 3.08	.88	13.26	.000
Time Climbing	2.54 ± 1.22	5.85 ± 6.02	.84	17.89	.000
Time Crawling	3.17 ± 1.07	5.20 ± 5.47	.92	8.61	.003
Time Maneuvering	9.27 ± 4.19	13.10 ± 7.01	.89	11.46	.001
Time Transporting	4.58 ± 2.26	8.84 ± 11.67	.92	8.34	.004
Total time	15.71 ± 13.67	40.12 ± 31.81	.78	37.33	.000
Score Slalom	3.68 ± 1.47	4.00 ± 1.43	.99	1.27	.261
Score Climbing	4.96 ± .39	4.50 ± 1.28	.93	10.96	.001
Score Crawling	4.74 ± .73	4.92 ± .28	.99	2.06	.151
Score Maneuvering	4.24 ± 1.12	3.72 ± 1.47	.97	4.87	.027
Score Transporting	4.15 ± 1.21	3.44 ± 1.44	.95	8.14	.004
Total score	21.76 ± 2.70	20.58 ± 3.48	.97	4.43	.035

Excepting the scores for the items slalom and crawling, all other variables show highly significant differences between groups in both split times and scores as well as the total time and total score.

Discussion

The aim of this study was to investigate the first aspects of validity of the new MobiScreen for children from six to eight years.

In the first step, a univariate ANOVA should show if there are differences between age groups and sex of the children. Only the split time for the transporting task shows a significant F value. Here, the 8-year-old boys need about ten seconds, compared to all other groups that need about four or five seconds. This could be due to the fact that in this group were the most children with a medical diagnosis.

To test construct validity, the item split times and scores were tested for their suitability for main component analysis. Both achieved significant KMO values and could thus be subjected to a main component analysis. The split times clearly show the assumed one-factor model of mobility. The scores show a two-factor model. Thus, the assumed model of mobility is not confirmed here. This may be due to the item difficulties or to the scale.

The discriminant analysis shows highly significant differences for nearly all variables, excepting the scores for slalom and crawling. On closer examination of the individual values, it can be assumed that the children with a medical diagnosis have motor deficits or even disorders, since in some cases they are 1.5 standard deviations below the values of healthy peers, as described in the ICD (***, 2005).

Conclusions

1. The new MobiScreen for first and second graders shows the one-factor model of mobility as assumed.

2. The new MobiScreen for first and second graders can differentiate between healthy children and children with a medical diagnosis.

3. As a consequence, the current version of the MobiScreen can further be validated (criterion validity and diagnostic accuracy).

Conflict of interests

There are no conflicts.

Acknowledgments

This work was funded by the German Sports Teacher Association (DSLV Saar). There is no financial interest or benefit in this work. Data collection was supported by the help of students of sports sciences.

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